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H. WINNETT ORR, M.D., F.A.C.S.

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H. WINNETT ORR, M.D., F.A.C.S.
LINCOLN, NEBRASKA

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TREATMENT OF OSTEOMYELITIS AND OTHER INFECTED WOUNDS BY DRAINAGE AND REST[1]

By H. WINNETT ORR, M.D., F.A.C.S.
Lincoln, Nebraska

WHEN Sir Joseph Lister undertook to apply the discoveries of Pasteur to surgical practice 50 years ago, he had one definite idea. His idea was that if fermenting micro-organisms could be excluded from wounds and if their activity could be inhibited by antiseptics, putrefaction, pyæmia, and the long train of wound complications could be avoided. Time and the weight of clinical evidence have proved that he was right. In his own lifetime, however, Lister departed from the use of carbolic acid and primary antisepsis or asepsis and embarked upon the search for a universal antiseptic. Lister's second choice was boracic acid.

We have sailed on many seas since Lister's time and thousands of other substances and combinations have been employed in the search for the ideal antiseptic.

Since the time of Lister, the usual conception of wound treatment has been that infection must be met and defeated by antiseptics. It should be remembered that infections of all kinds had been successfully

[1] Annual lecture in Orthopedic Surgery, January 25, 1927, Mayo Foundation, Rochester, Minnesota.

overcome long before the time of surgeons or antiseptics. A study of the fossil remains of pre-historic animals reveals the presence of healed lesions of bone and joint infections of many kinds. Out of our present day notion as to the importance of antiseptics, there have developed certain errors in surgical practice to which I wish to call your attention and for which it is desired to propose a remedy.

In our use of antiseptics there undoubtedly has often been the same misapprehension with regard to cause and effect that obtains and has obtained in the use of other substances used as remedies in other kinds of disease. We have had occasion to try and to abandon hundreds of substances which were at one time relied upon as curative. Now we know that in diseases of many kinds recovery takes place quite regardless of the medicinal agents employed. If we scrutinize the methods employed in wound treatment, we shall have reason to doubt whether it has been generally discovered or recognized that infected wounds do heal without the application of antiseptic agents of any kind.

Before the antiseptic period the usefulness of certain agents in preventing fermentation of all kinds had been demonstrated in many ways.

For the preservation of human bodies after death, there had been developed methods over which very little improvement has been made. The control of fermentative processes outside of the body was being given considerable attention, although no high degree of perfection was reached until the

discoveries of Pasteur. Substances and combinations similar to those used in embalming had been used to a certain extent in the treatment of wounds. They were used, for the most part, empirically because they seemed to promote healing.

Lanfrank[1], in the 14th century, had formulated quite definite and fairly successful methods of dealing with simple and infected wounds. He advocated and employed compresses, sutures, and special dressings for wounds of various kinds. He quoted from both Galen and Avicenna to emphasize the point that no attempt must be made to close septic wounds until they had been cleaned up.

Lanfrank reports a case in which primary healing occurred and says: "I found the wound and the vein all healed and the father and all the neighbors had great wonder."

One encounters the same sort of astonishment whenever patients are seen who are recovering and whose wounds are healing without active antiseptic treatment. It has, somehow, become a notion prevalent among the laity, as well as current in the profession, that a certain amount of treatment with poultices, packs, irrigations, or antiseptic powders or pastes is necessary to persuade a wound to heal. The healing of a wound without any of these things is usually looked upon as an interesting and unusual phenomenon. It is the intention of the writer to show that wound healing may be brought about regularly without daily dressings or irriga-

[1] Lanfrank. Science de Cirurgie, Ashmole MS., 1396, Early English Text Society, Orig. Series 102, 1894.

tion with antiseptics, and that there is an easier and better way to promote healing of wounds. The important factors in securing such results are primary asepsis or antisepsis when required, adequate drainage, immobilization of the injured parts, and protection of the wound against disturbance and reinfection.

Since the time of Lister there has developed a disposition on the part of the profession to regard wound treatment as a contest between the germs in the wound and the antiseptic that is being employed. (For severe infections more and stronger antiseptics!) To a certain extent the facts have been lost sight of that on the one hand, with every infected wound there is a certain amount of septicæmia against which the patient must battle himself, and which also may become better or worse according to the wound treatment employed; and that, on the other hand, not only may the antiseptic treatment employed be entirely inadequate to cope with the infection, but that it may be more irritating than beneficial to the patient. Moreover, along with the so-called antiseptic dressings, additional infection may be introduced into the wound from the air, from soiled dressings or instruments, or from the fingers of the one who is dressing. Many of these points have received too little consideration. Finally, and more important, is the point, that, as a factor in the treatment of any inflamed process, rest has long since been demonstrated to be a therapeutic agent of great importance. Rest for the wound means infrequent dressing; rest for the injured or inflamed part of

the body means protection against movement, relief from muscle spasm, relaxation in correct position—that is to say, efficient immobilization.

Dr. Singer,[1] in her life of Paré, directs our attention to the methods of wound treatment worked out by Paré and by his predecessor, Joubert (1570). Joubert was a skilled medical botanist and a learned physician. Toward the end of his life, he employed pure spring water only as his dressing for wounds. Commenting upon this, Paré said: "As for some empiricks who cure simple wounds merely by application of linen, either dry or soaked in water, and sometimes cure them, it is not necessary to believe there is enchantment, or a miracle, as do idiots and the populace, but merely in the beneficent action of nature, who cures wounds, ulcers, fractures, and other ills. For the surgeon does no more than aid her by removing the hindrance, as pain, flexion, inflammation, and infirmity or other things that cannot be moved by nature alone."

The experience of Paré which led to his simplification of wound treatment is quite generally known. The prevailing treatment for gunshot wounds in his day was cauterization with boiling oil. On one occasion, the supply of oil having been exhausted, he related the following experience: "It chanced on a time, that by reason of the multitude that were hurt, I wanted this Oyle. Now because there were some few left to be dressed, I was forced, that I might seeme to

[1] Singer, Dorothea Waley. Ambrose Paré. London: John Bale Sons & Danielson, Ltd., 1924, pp. 62–63.

want nothing, and that I might not leave them undrest, to apply a digestive made of the yolk of an egg, oyle of Roses, and Turpentine. I could not sleep all that night, for I was troubled in minde and the dressing of the precedent day (which I judged unfit) troubled my thoughts, and I feared that the next day I should finde them dead, or at the point of death by the poyson of the wound, whom I had not dressed with the scalding oyle. Therefore, I rose early in the morning, I visited the patients and beyond expectation, I found such as I had dressed with the digestive only free from vehemencie of pain, to have had good rest, and their wounds were not inflamed, nor tumifyed but on the contrary the others that were burnt with scalding oyle were feaverish, tormented with much paine, and the parts about their wounds were swollen. When I had many times tried this in divers others, I thought this much, that neither I nor any other should ever cauterize any wound with Gun-Shot."

In discussing the treatment of compound fractures, John Hunter,[1] calls attention to the difficulty of combining wound treatment with the maintenance of immobilization. He says: "A variety of inventions have been employed to prevent this motion; but the dressing of the wound every day counteracts the effect of every invention that has been thought of, and it is perhaps impossible to dress the sore without motion." It is interesting to note in this connection that

[1] Hunter, John, Works of, by James F. Palmer. Philadelphia: Hawell, Barrington & Haswell, 1841.

the double inclined plane splint in the form of fracture boxes, and a specially constructed bed are suggested in the footnotes by the editor of this edition of Dr. Hunter.

By the work of Hilton[1] (1807–1878) and Thomas[2] (1834–1891) we are taught the control of inflammatory processes by methods designed to conserve body resistance. Hilton and Thomas, better than any others, have demonstrated the tremendous ability of the body forces to deal with infection. Hilton showed over and over again, the value of rest in combating chronic, or, what we might call, low grade infections. He proved that prolonged rest was *the* therapeutic agent of importance. Following Hilton, Thomas was the first to work out a satisfactory method and appliances by which rest could be obtained. With the advent of Pasteur and Lister, we had the opportunity, which, in the mind of the present writer, has never been taken advantage of, to apply the principle of rest to the treatment of the more acute and more severe infections, especially to compound infected wounds of the bones and joints. Lister certainly showed us the way to the prevention and to a certain extent, the control of the putrefactive and parasitic processes resulting from the invasion of wounds by septic microorganisms.

It is now proposed to show that by a successful combination of the principles ex-

[1] Hilton, John. Rest and Pain. W. H. A. Jacobson, 5th ed., pp. 514, A. Bell & Son, 1892.

[2] Thomas, Hugh Owen. Diseased Joints, Part II of Contributions to Med. & Surg., pp. 151, 1883; Fractures and Dislocations, Part VI, v. s. 104 pp. H. K. Lewis Co., 1886.

pounded by Lister[1] with those of Hunter, Hilton, and Thomas, there can be developed entirely adequate methods for dealing with wounds and wound infections.

What has happened in recent practice is, that to a large extent the value of rest in its best sense has been forgotten. Listerism has been construed to demand active chemical antiseptic treatment of wounds. The greatest possible confusion has prevailed as to the methods by which chemical antisepsis is to be obtained.

Keyes, in 1902,[2] was endeavoring to compromise the various methods that had been proposed. Speaking of compound fractures, he said, for example: "The splint should be applied to the limb before the patient leaves the operating table. If the wound is expected to run a clean course a fenestrated plaster encasement is best, reinforced if necessary, by iron bands. If, however, suppuration is feared and daily dressings are expected, such a splint soon becomes soiled and soaked with discharge from the wound, in spite of every precaution.

"The treatment of wounds is of the greatest importance, while the primary irrigation and antisepsis are chiefly to be depended upon to prevent infection, the *irritation as well as the danger of infection from the frequent change of dressings is a common cause of the late suppuration.*" Keyes concludes, however, in the

[1] Lister, Sir Joseph. On the Effects of the Antiseptic Treatment upon the Salubrity of a Surgical Hospital, 1870; and A Contribution to the Germ Theory of Putrefaction and other Fermentative Changes, 1875.

[2] Keyes, Edw. L., Jr. Fractures. Woods Ref. Hand Book of the Medical Sciences, 1902.

manner common to the practice of the present time with the following:

"If the wound is but loosely sutured and lightly packed in the first place, it may sometimes be left undisturbed until the fourth day. If at the first dressing the wound is clean, it should be disturbed as little as possible. Some of the drainage may be removed. *The wound should not be irrigated.* After this the dressing is renewed at intervals of from forty-eight to seventy-two hours until the wound is healed. If active suppuration occurs *it must be combated by the usual antiseptic methods.*

"If drainage has been used the wound should be dressed at the end of twenty-four to forty-eight hours, and the gauze or tubes removed.

"The appearance of infection in a wound demands the establishment of *free drainage and the use of antiseptic irrigation.* The application of a hot moist antiseptic dressing will often prove beneficial."[1]

The above paragraphs represent the tendencies of wound treatment as carried out by most physicians and surgeons at the present time. Even a clean wound is scarcely permitted to rest and if infection supervenes or exists at the beginning, all considerations of splinting or immobilization (rest) are cast to the winds in the interest of irrigation, packs, etc.

Since the writer began the study of methods and results in the treatment of wounds, he has found it extremely difficult to arrive at any definite opinion or to obtain definite opinions from others in regard to results of

[1] Italics by the writer of the present article.

treatment. There are thousands of published articles reporting satisfactory results with this method or that in the antiseptic treatment of wounds, but, as statistics are sought with regard to final results with reference to deformity or disability following osteomyelitis, infected fractures or suppurative joints, they are extremely difficult to obtain. Patients are almost invariably discharged from hospital and even from treatment before they are healed, and the final healing with the amount of disability that results, is something for which we can obtain no statistics in ordinary surgical and hospital practice.

At the time of the military draft in 1917, out of the first million and a half men examined, an astonishing amount of disability in the extremities as the result of ununited and mal-united fractures and infections of the bones and joints, was found. Forty-five thousand men, or 2 per cent of all those examined, were found to be seriously disabled on account of these conditions. In the Surgeon General's report the causes were said to be "the liability to accident to which young men are subject often in localities where a good surgeon's attendance cannot be secured." However, the percentage of disability for urban and rural cases does not differ as widely as might be inferred from the above comment. It was found, in fact, that with respect to mal-union of fractures, a condition in which a decided percentage in favor of cities might be expected, no such difference developed. For ankylosis of joints

following injury and disease, the comparative percentages are also interesting.

	Urban	Rural
Mal-union of fractures—upper extremity.	1.5	1.6
Mal-union of fractures—lower extremity.	2.2	2.7
Ankylosis of joints	3.2	3.5

Other observations by the writer seem to bear out the general conclusion that differences in disability following fractures and the treatment of other bone and joint wounds do not arise from differences in skill between individuals or groups in the medical profession, but that the shortcomings in treatment which lead to disability are common to the profession as a whole. These faults as revealed by the present investigation are several; first, the tendency to pay earliest and principal attention to the antiseptic treatment of wounds by pads, packs, irrigations, and the like; and second, to neglect those fundamentals essential to obtaining and maintaining correct length, position, and rest for the injured and infected parts.

Listerism, as applied to the performance of aseptic operations, has been perfected and improved to a remarkable degree. But Listerism as applied to the treatment of infected wounds in general practice nowadays, is scarcely as good as in the days of Lister himself. It must be understood that Lister[1] conceived of antiseptics as a means of preventing rather than controlling putrefaction. Lister says, "for it is hardly needful to point out that neither the spray nor the carbolic acid applied externally, nor the oiled

[1] Lister, Sir Joseph. On recent improvements in the details of antiseptic surgery. Lancet, London, 1875, March 20, p. 402

lint inserted in the outlet to serve as a drain could correct putrefactive fermentation once established in the abscess cavity. Here, as in the antiseptic treatment generally, the means are calculated to prevent, not to correct, putrefaction."

Primary asepsis and the protection of the wound for which Lister contended so valiantly, have been to a large extent forgotten in the restless quest for a method or agent which would do what no agent so far has ever done, namely, sterilize an infected wound without damaging the patient.

Listerism properly understood and properly applied has conferred countless benefits upon surgical patients and has enabled the surgeon to go far with his operative methods and his surgical technique. Listerism misunderstood and badly applied has, on the other hand, inflicted an immense amount of suffering upon patients with infections and has been responsible for deformity and disability that could have been prevented by less strenuous and more thoughtful treatment.

The following case report (McNamara) is fairly typical of what happens to children with severe acute osteomyelitis. Different writers have given the mortality as from 20 to 50 per cent in such cases. Radical drainage is commonly advised against. It is the opinion of the writer that with the plan of treatment to be described later, the results should be just as good as in acute appendicitis. Early diagnosis, adequate drainage, and rest are necessary.

"M. A. D., aged 10, admitted in the hospital on

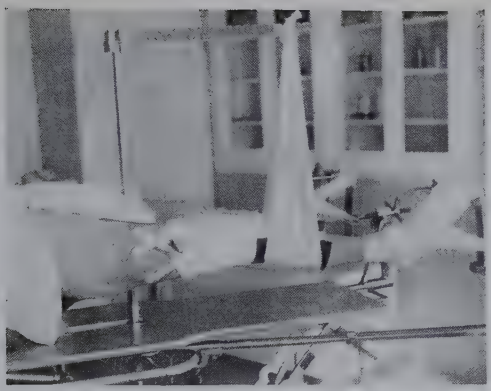

Fig. 1. Case 1. L. H. Condition of patient upon arrival at the hospital. Daily antiseptic dressings for several months. Sequestra, inadequate drainage, etc.

January 20.[1] The child's mother states that 10 days ago the patient came from school saying she had fallen and hurt her foot. She limped from this time, but until January 22, was able to move about; she was then, while seated in her chair, seized with a violent fit of shivering. The shivering lasted for an hour or so, and recurred again in the evening. During the night the child became delirious. On the 25th she was admitted to the medical ward of the Westminster Hospital as a case of acute rheumatism. On the following day, I was requested to see the child in consequence of the inflamed condition of the left ankle joint. I found the patient bundled up in bed with her knees and thighs flexed; she had the piercing scream of a child suffering from meningitis; her pupils were contracted, her features drawn, almost convulsed, she could not bear the light. The slightest effort to move any of the patient's limbs greatly increased her agony; there were numerous small hæmorrhagic vesicles over the skin covering her chest and abdomen. The patient's temperature varied from 103 to 105 degrees;

[1] Vide McNamara, bibliography.

her lungs were seriously implicated. On examining the left ankle I found a swollen condition of the soft structure over the outer malleolus, extending upward some 2 inches along the shaft of the bone. On passing a grooved needle into the part, pus exuded along the instrument, and I, therefore, made a free incision down to the bone, which was bare of periosteum, and the lower end of the diaphysis was necrosed and separated from the epiphysis. The patient's constant piercing cry was so distressing that she was removed to a special ward. But in spite of the careful nursing and treatment she died within a few days.

"On making a postmortem examination, we found the fibula necrosed and denuded of periosteum for some 2 inches from its inferior extremity, which was separated from the epiphysis. On section the cancellous tissue of the bone was found to be inflamed, with a number of small abscesses extending upward along the interior shaft of the bone. On opening the right and left hip joints, the left shoulder, the sternoclavicular, and the metacarpo-phalangeal joint of the left little finger, we found the synovial membranes extended with pus; the other joints were not opened. On examining the brain, we discovered the membranes to be deeply injected with blood extravasated into the cortical substance of the brain. In the lungs numerous foci of suppuration were observed, and similar infarctions were found in the lining membrane of the right side of the heart."

The points which require emphasis in commenting on an experience like the above are that adequate drainage, antisepsis, and rest have apparently all been neglected. A surgical opening of sufficient size and extent to drain the primary focus in any bone infection is the first indication. In such a case as this, metaphyseal or medullary drainage of the first bone infected is definitely indicated. An attempt to reduce the amount of local infection

at the time of operation by a fairly powerful antiseptic is the obvious next step; at that point the teachings of Lister and Thomas may be applied. The primary dressing should be such a one as to prevent further invasion of the wound by septic organisms, and there should be applied suitable mechanical devices to put the diseased parts and the patient at rest.

Repeated experiences have confirmed the original observations of the writer that such treatment is just as beneficial in acute infections of bone, whether in primary osteomyelitis or in secondary infections following injuries, as Hilton and Thomas found them to be in the chronic infective diseases of bones and joints with which they report to us so extensive an experience.

In regard to the method of drainage or the type of operation to be employed, it is believed that in the early and very acute cases the simple opening (nearly always through the bone) into the abscess cavity is all that is necessary. The surgical opening, however, must be kept wide open; drainage through a tube or leakage between sutures is insufficient.

McNamara concludes his discussion as follows: "Patients, I am persuaded, have died from not having the inflamed tissues sufficiently incised; but I doubt if a child has ever lost his life in a case of this kind, from the surgeon having made too free use of the knife,"—a sentiment with which the author of this paper heartily agrees. In fact, it is believed that we should go further and say

Fig. 2.

Fig. 3.

Fig. 4.

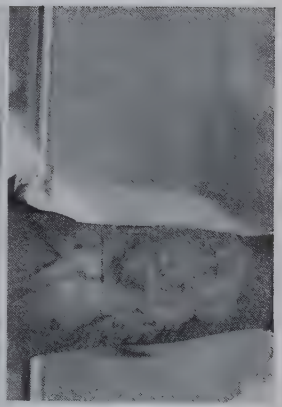

Fig. 5.

Fig. 2. Case 1. Cavity remaining after removal of sequestra. "Saucerization" or "effacement" of diseased area.

Fig. 3. Case 1. Entire cavity—bone and soft parts—being packed widely open with vaseline gauze.

Fig. 4. Case 1. Cavity and entire wound packed open with vaseline gauze. No stitches are employed.

Fig. 5. Case 1. Final covering with vaseline gauze. This is covered in turn with an absorbent cotton dressing.

that not only the knife but the chisel should be used more freely in these cases since the common error of the time is to neglect to provide the medullary drainage which is always required.

Starr,[1] of Toronto, has obtained some brilliant results in the treatment of early cases by making drill holes into the ends of the diaphysis and into the epiphysis. This is better than the treatment previously employed because in similar cases previously no drainage whatever had been provided so early for the interior of the bone. It is, of course a fact, that, in very early stages, by making an opening through the periosteum with drill holes into the bone, with drainage and immobilization, a considerable number of these patients will be relieved. The author contends, however, that a larger window into the bone with the wound packed wide open and with adequate immobilization, will provide better drainage, can be done as quickly with no more harm to the patient, and will most certainly arrest the progress of the infection.

Ochsner[2] in an address before the Utah Medical Society states: "Primary operation should consist of splitting the periosteum to and above and below the painful area and lifting 1 to 2 centimeters on each side; as a rule this should be the extent of primary operation. Hot, moist dressings with electric light treatment hasten recovery."

Dr. C. C. Chatterton of St. Paul, says:

[1]Starr, Clarence. The treatment of compound fractures of long bones. Illinois M. Soc., 1924, June.

[2]Ochsner, A. J. Acute hæmatogenous osteomyelitis. Arch. Surg., 1922, May; California St. J. M., 1924, xxii, 3.

"Moist dressings, hypochlorite, normal saline, or boracic acid may be used as aids to drainage but discontinued upon any signs of maceration of the skin. A small catheter may be introduced in the opening and Dakin's method used or tidal wave irrigation with various antiseptic fluids introduced, but hospitalization is necessary in this type of treatment." As I shall show you in a moment, I think this is wrong. Finally, Dr. Dean Lewis refers to this kind of case as follows: "In the acute cases in which subperiosteal abscess has formed, I believe that drainage of the abscess is first indicated. If the fever does not subside and the general condition improve, or there is definite evidence of a suppurative process in the marrow, the cortical bone should be removed and the marrow cavity drained."

Delay in providing adequate drainage for the infected bone areas is a common defect in the treatment of osteomyelitis. The teaching has been prevalent that the bones are not to be opened until sufficient involucrum has formed to give strength to the diseased extremity and until complete sequestrum formation has occurred.[1] There is a certain period in the progress of an osteomyelitis when the advice to wait for this condition to come about may be correct. Too often, however, this counsel has been adhered to for many weeks when the patient suffers during the whole period for lack of drainage.

It is contended that many of the poor

[1] Brickner, W. M. Attenuated bone infections. J. Am. M. Ass., 1925, December 25.

results and much of the confusion in regard to present methods is due to a failure to relate and combine the well known principles of asepsis, drainage, antisepsis (at the proper time) and rest.

Tons of antiseptic chemicals and oceans of antiseptic solutions were employed during the Great War for the treatment of wounds. Most of the wounds would have healed without the application of any antiseptic whatever. During the War we employed, to too limited an extent, and too inefficiently, the one therapeutic agent that is absolutely essential—I refer to rest. It is upon rest that the human body depends to a large extent for its ability to withstand and to resist the secondary effects of injury and infection. In open wounds this rest must include not only the relaxation and support of the injured part as a whole, but protection and relief from irritation for the open wound that has been exposed to invasion by micro-organisms. No amount of flooding with antiseptics or of sterilization by irritating solutions will compensate for continuous disturbance of the open wound and irritating motion of a compound fracture. Primary cleansing, free drainage, and absolute immobilization are necessary to approximate ideal treatment.

Secondarily, we must have protection of the wound against re-infection and a concontinuous relaxation of the diseased part until healing occurs. It was in an effort to find a combination of factors in treatment that would approximate this ideal that the author was led some years ago to discard

Fig. 6 (left). Case 1. Plaster-of-Paris cast applied to entire limb. In children and some adults a spica or even a double spica is employed.

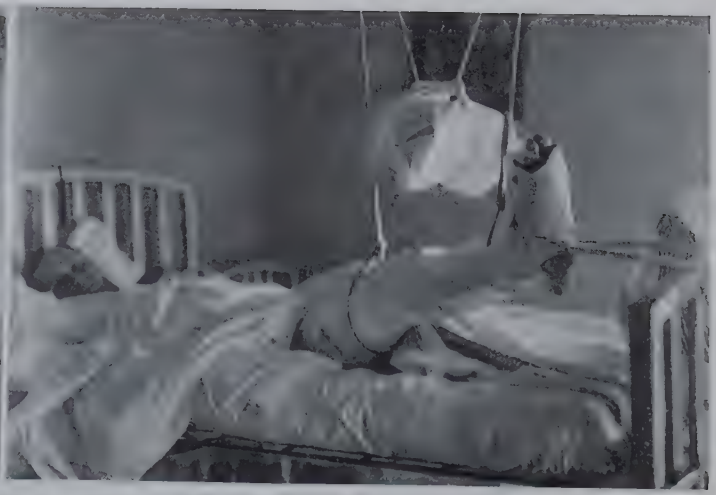

Fig. 7. Case 1. Position of patient with leg cast in bed. When a double spica is employed the foot of the bed is raised and 20 to 30 pounds traction applied to the cross bar.

practically all of the accepted methods of antiseptic wound treatment in an effort to provide rest for the injured part and subsequent protection for the wound. To summarize: The propositions upon which the treatment of wounds by drainage and rest was worked out are as follows:

1. Primary asepsis or antisepsis to reduce the focal infection (at the point of acute disease or injury). It is not attempted to remove all infection or all diseased tissue. The patient is relied upon to take care of a part of his infection if he is properly assisted and protected.

2. Adequate drainage (wide open to the depths of the infected area).

3. A postoperative dressing or method that will protect the wound and the injured or diseased part so that the wound and the part are at rest and there is no opportunity for re-infection.

4. Immobilize (not simply apply a splint) so that movement, pain, and muscle spasm are entirely relieved, and with all the parts in correct position for recovery with a minimum of deformity and disability.

One of the lessons of the Great War was that most of the splints in common use served perhaps to handicap the patient's movements to some extent, but to immobilize very little or not at all. Moreover, splinting in nearly all cases was made secondary to wound treatment, and splints were disturbed (and are being today) upon the slightest provocation for wound treatment. My experience during the war and since has

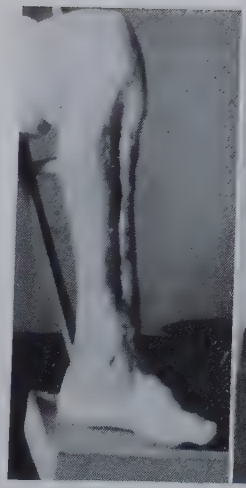

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 8. Case 2. T. T. Showing condition of leg and knee motion at end of one year. Very extreme case.

Fig. 9. Case 3. L. M. Showing bone defect and healed wound in the ordinary acute case—at the end of six months—about six dressings in all. In cast about 3 months.

Fig. 10. Case 4. End-result of compound fracture in the lower third of the leg at end of 12 months.

Fig. 11. Case 4. R. H. Lateral view of patient shown in Figure 10.

been similar to that of Osgood,[1] who says: "Plaster-of-Paris dressings with wide openings bridged by hoops of metal or plaster offers the most perfect fixation and greatest comfort to the patient. These are employed in specially difficult and painful cases. Their disadvantages in an English general evacuating hospital, where there are often periods of great rush, are their time consuming initial application and the practical certainty that *they will be removed when they reach the home hospital.*"

The lack of attention to splinting for immobilization and the preservation of correct position in these cases is frequently emphasized by demands on the part of patients that some protection be afforded for unstable and deforming extremities. The following quotation from a letter from one of the young officers following his return from France, is typical of many similar complaints that have been made. He says: "The half cast placed on the left leg in France was removed upon my arrival in the United States. I asked that the splints be resumed during the following months as I believed I could feel the foot drawing out of shape. However, no splint or brace was ever used until after I began to walk, when a plate under the foot with braces up the leg was used to take the weight off the foot. A modification of this brace was kept on until the date of discharge when it was removed. I have had no treatment since discharged. I limp slightly and do not know whether the leg is shorter or not; I think it is.

[1] Osgood, R. B. Am. J. Orth. Surg., 1917, xv, 668.

Fig. 12.

Fig. 12. Case 5. W. C. Osteomyelitis. Non-union 2 years after a simple fracture of the humerus. Five operations.

Fig. 13.

Fig. 13. Case 5. Six months after Figure 12. Two operations, 5 dressings, 3 casts, body and arm cast shoulder spica employed.

At times I cannot place any weight on the foot. The leg is undeveloped; it is a very weak sister."

In the interval between the time of Lister and the Great War the treatment of infected wounds had, if anything, become a little worse rather than a little better. The frantic search for new antiseptic agents left the surgeons confused and uncertain; in fact, almost panicky, when confronted by a large infected wound. The results when we were faced with the situations that developed during the early months of the War were what might have been expected. There was no uniformity either in the matter of antiseptics or methods of application; there was little or no splinting, and except for early and industrious use of such agents as we had, the result would have been much worse than it was.

This is one of the reasons why débridement and the "let alone" policy advocated by the French made such a striking impression; there were a lot of good results. If the same principles had been applied to the wounds that were left open that were applied to those which it was found possible to close (the principle for which the writer is contending) the results would have been better still.

Primary asepsis and early protection as taught by Lister; continued protection and rest for the wound and the injured part, as taught by Thomas, are the two outstanding methods necessary to secure results, and these received their vindication during the War.

The attitude of the writer toward these questions began to change during his experience in Great Britain and France in 1917–18. This is indicated by the following circular which he prepared in November, 1918. This was distributed with the approval of the commanding officer of the Savenay Hospital Center and the commanding officers of hospitals at Angers, Nantes, and St. Nazaire, to all ward surgeons. Additional copies were also prepared at the request of Colonel Goldthwaite and sent to other hospitals. This circular in itself tells so much about the orthopedic side of the surgery in Base Hospitals that it is quoted as follows:

Hq. Hospital Center,
Savenay,
28 November, 1918

Memo No. 178

The following is published for the information and guidance of all concerned:

By direction of
W. E. Cooper,
Lt. Col., M. C., Commanding Officer
C. S. Adams,
1st. Lt., San. Cps., Adjutant

INTRODUCTORY

Certain data and conclusions resulting from a study of several thousand orthopedic cases at Savenay are submitted herewith as suggestions to the surgical services and the surgeons of this area. This information has been collected at the request of the Consultant in Orthopedic Surgery (H. Winnett Orr, Major, M.C., U.S.A.)

The conclusions reached have been concurred in by the officers whose names are attached (Major Philip D. Wilson and Capt. Leroy C. Abbott). It is believed that the safety and comfort of patients

Fig. 14. R. S., Case 6. Condition of patient in January, 1927. Soundly healed and has remained so.

being prepared for and sent on convoys to the United States would be materially improved by an observance of the suggestions following:

THE TREATMENT OF ORTHOPEDIC PATIENTS IN BASE HOSPITALS

The considerations involved in the treatment of war wounds in Base Hospitals must be made to

include not only the existing and imminent surgical pathology but the ultimate position and function of the injured parts as well. It is these latter points which in both civil and military surgery operators have been prone to overlook. A bleeding or infected wound, especially if of considerable size, makes an immediate and urgent demand upon the surgeon's attention. *There has been a tremendous accumulation of evidence in this war to prove, however, that wounds of whatever size and character heal better if all the parts involved are restored immediately to and adequately maintained in as nearly as possible normal anatomical relations.* The different effects of such treatment upon the patient's ultimate career should be almost too obvious to require comment. *It is a fact, however, that not only because of the stress of war conditions, but because of the failure of surgeons to interest themselves in what for convenience must be called the orthopedic viewpoint, many of these patients in Base Hospitals for treatment or in preparation for convoy to the United States have not been dealt with adequately in this regard.*

The long discussion over the relative merits of motion, traction with motion, traction in bed, ambulatory traction, immobilization without traction, etc., fairly indicates the state of mind that has continued with regard to splinting, plaster casts and methods of immobilization of all kinds. Hilton, Thomas, Ridlon, and other sound orthopedic surgeons have never been afraid of rest—in bed or in splints. It is inflammation and the effects of inflammation that are to be feared. All of the immediate and remote effects of immobilization (if properly done) are to be seen in the relief of pain, the reduction of inflammation, the prevention of muscle spasm and deformity and lessening of ultimate disability (ankylosis, contractures, etc.).

Inflammation, on the other hand, if not prevented or controlled, leads inevitably to the adhesion of muscular and tendinous structures, erosion of articular surfaces, and fibrous and bony ankylosis.

"When long continued inflammation has rioted in the tissues of a joint, deforming the articular surfaces and locking them up in organized lymph and shortened ligaments, we have ankylosis, the ultimate degree of which will depend, in my opinion, on the promptness and success of our efforts to arrest the inflammation. And I think that we are wrong when we fear adding to the amount of ultimate ankylosis by early and thorough fixation of the joint. To me it seems reasonable that such a course will diminish the resulting ankylosis by subduing the inflammation and preventing an excess of its products also."[1]

Ridlon[2] was one of the earliest and most intelligent exponents of the importance of rest in the treatment of tuberculous joint disease. All of his arguments apply with equal force to the control of motion, the relief of muscle spasm, and the arrest of inflammatory processes in the treatment of infected wounds. This is particularly true in joint wounds or in those bone and soft part infections that lie in the vicinity of joints. Many experiences in the treatment of severe infections, both acute and chronic, in the neighborhood of the hip and knee have convinced the author that complete immobiliza-

[1] Judson, A. B. Med. Rec., 1886, xxxix, 497.

[2] Vide Bibliography.

tion of the parts (double plaster spica) is of the greatest importance in securing recovery for such conditions. Adequate fixation of an acute suppurating knee or hip joint in a well fitting double plaster spica, will not only afford immediate relief to the patient in the matter of pain, but it will turn the tide against the spread of infection, septicæmia, etc., and in favor of the patient. Drainage, is of course, usually important or necessary but immobilization is absolutely indispensable to a rapid and comfortable convalescence.

The author's method for the treatment of osteomyelitis may be illustrated by an account of a typical case.

Miss E., nurse, age 21. This patient developed an acute inflammatory condition in the left foot in January, 1923. The foot was immediately incised but local and general sepsis progressed. Further incisions were made in all parts of the foot and leg following the tendon sheaths and fascial compartments as is customary in such cases. I saw her at the end of the seventh week. She was in serious condition with an enormously swollen leg which had been freely incised and continuously fomented or irrigated for weeks. She had marked hip, knee, and ankle contracture deformity. The foot and leg were badly macerated and very foul because she would not tolerate any cleaning up measures. X-ray at this time showed a destructive bone lesion involving the tarsus which had apparently never been drained. (It may be mentioned that at this time the pain was so severe that she was receiving ¼ grain of morphine every four hours.)

Upon my advice she was taken at once to the operating room and a thorough drainage operation into the tarsus was done. A good sized abscess cavity was found and cleaned out. The wound was packed well open with vaseline gauze and then the hip and knee were straightened out. With a little

force the foot was brought up to a right angle with the leg. All of the other open incisions were merely wiped off (or out) with iodine and rinsed with alcohol. A sterile sheet cotton bandage was put on over the gauze dressing and a long cast put on. The patient was put to bed with the leg in suspension and traction. For the first day or two she still clamored for morphine but received none after the third day. At the urgent request of her previous surgeon I did a dressing on the tenth day. There was no discharge and the wound looked healthy. None of the other incisions gave the slightest trouble. This patient was in a cast for 3 months. Then a posterior iron was put on. The wound was entirely healed and has remained so. There is a little equinus and varus deformity but with a special shoe no disability whatever. For the past two and one-half years she reports that she is able to do as much on her feet as she ever did.

The earlier cases treated by the method of drainage and rest did so well, the care of the patients became so much easier and the end-results were so satisfactory that as time went on we were able to go further and further in lengthening the periods of immobilization and non-disturbance of the wound. Not only have very serious wounds healed without much treatment, but highly septic patients have recovered when recovery was not to be expected with ordinary treatment. Distribution of sepsis has certainly been reduced and body resistance to infection has certainly been fortified by this policy of what might be called "extreme rest." Patients with extensive contracture deformities due to muscle spasm have been put at rest in a few hours by very extensive inclusion of the body and the extremities in plaster of Paris. The treatment of the wound both as to primary

operation and as to secondary care has been reduced to almost nothing on the proposition that drainage and rest are the only factors of any particular importance. The exact technique worked out during the years immediately following the War was as follows: (See illustrations for Case 1.)

1. Make a fairly large incision over the infected bone area. Spread apart the skin, muscles, fasciæ, and periosteum just far enough to afford access to the diseased area and no farther.

2. Chisel a window into the affected bone area large enough so that all diseased bone may be removed and so that there are no overhanging edges of bone over the diseased area. (Less extensive in acute cases.)

3. Clean out the diseased area gently with a curette or gouge, being careful to refrain from unnecessarily damaging the tissues undergoing repair.

4. Dry the wound and wipe out with 10 per cent iodine followed by 95 per cent alcohol.

5. Pack the entire wound wide open but not tightly with a sterile petrolatum gauze pack. Cover this with a dry sterile pad and bandage on.

6. Now perform any reasonable forcible manipulation necessary to place the parts in correct anatomical position for splinting (abduct the arm to 90 degrees in humerus cases; dorsiflex and supinate the hand in forearm and wrist cases; dorsiflex the foot to a right angle with the leg, in leg and foot cases, etc.)

7. Apply a plaster cast (preferably) or a

suitable splint so that the parts are thoroughly immobilized in comfortable and correct position (additional weight and pulley traction, Balkan frame, or even ice tongs or bone pins may be used in these infected bone lesions associated with fractures and old fracture deformities which are being corrected at the same time as the clean up operation.) It may be said that it is in the latter cases that some of the most gratifying results may be obtained by this method.

8. Finally, the cast is not to be split nor are windows to be cut in the cast until the wound dressing becomes necessary. And the *wound is not to be dressed* at all unless there is a rise of temperature or other signs of acute sepsis. As a rule, no dressing is necessary except on account of odor, and this may not be required for several weeks. In a majority of cases the patient treated by this method will go through to complete healing with a few dressings at intervals of from 10 days to 4 weeks.

It may be said that the claims for superiority of the method proposed by the author rest upon empirical rather than upon scientific grounds. There is a lack of the chemical, bacteriological, and statistical evidence commonly adduced in support of contentions of this sort.

In the words of Flexner,[1] however, "There is a widespread impression that the scientific quality of medical practice is in some fashion dependent upon the part played by the

[1] Flexner, A. Medicine and Medical Education. New York: Macmillan Co., 1925, p. 5.

laboratory. This is not the case. Science is essentially a matter of observation, inference, verification, generalization."

In considering the technique of treatment by drainage and rest, it is important to emphasize the points that neither partial closure of the wound by stitches nor tube drainage comply with the requirements as the writer of this paper sees them.

The rubber tube drain not only irritates as any other foreign body will do but serves as an inlet or carrier for infection. The partial closure of such wounds by sutures serves to cover up areas or pockets of infection and militates against sound healing of the wound as a whole. What is desired in such cases is to obtain granulation of a broad surface and a skin covering as in any other superficial wound.

The adoption of the method of wound treatment by drainage and rest meets with certain difficulties because it calls for a change in attitude on the part of surgeons toward this entire problem. The technical methods proposed although differently arranged, are not new. Moreover, from the standpoint of most of us, our methods, heretofore, have given us generally quite satisfactory results; in other words, we "get by" very well. There has been, however, a much larger percentage of unsatisfactory results than we realize. Because the patients do not complain very much and because our work is as good as the average, does not indicate that we may not do much better.

I am reminded of a patient who was

limping out of the hospital at the end of the seventh week following what should have been an aseptic appendectomy. She thought she had the best surgeon in the world, because, although she had become infected at the time of operation (which she did not know) he had dressed the wound himself twice daily for the 7 weeks, and she had finally recovered. Many of our cases of osteomyelitis pursue a course like this or worse, and because life and limb are saved they think they have had the best possible surgical treatment.

Since the War period, more and more emphasis has been placed upon the surgical operation in chronic osteomyelitis. In chronic osteomyelitis, the operative method referred to by Ryerson as "saucerization," or by Mebane as "effacement" is the ideal procedure. This has the effect already referred to of converting a deep pocketed bone abscess into a superficial wound, healing occurring evenly from the bottom up and giving us much greater freedom from subsequent complications than has been customary heretofore.

Since the "rest treatment," as described by the author was first proposed, one of the commonest questions asked has been with regard to his attitude toward acute cases. There are several important points that require consideration in the discussion of this matter. In the first place, the disposition, heretofore, has been to employ methods that provide a minimum rather than a maximum of drainage. The popular methods

have been those of an incision through the periosteum, drill holes into the medulla and into the epiphysis only, and other procedures that might be called minimum rather than maximum.

There are in literature numerous assertions by competent observers to indicate that, if not at once, at least very early in practically all cases, there is pus in the bone marrow. It has also been pointed out that drainage into the bone marrow in early cases will do no harm if pus is not encountered. We have had several illustrations of this point. In Case 3, an opening was made into the bone marrow and no pus was found. This case healed almost without drainage. It was significant that in this case pain, swelling, and other symptoms including a marked leucocytosis were markedly relieved within 48 hours. In this patient healing took place within a few months and she has had no recurrence.

Among the advantages which should be emphasized for the treatment of these conditions by drainage and rest alone, none is more important than the relief afforded the patient.

In children especially, the infrequent dressings following an operation for osteomyelitis, make the greatest possible difference not only in reducing the amount of suffering but in an improvement as to rest, appetite, and general condition. Even adults who stand frequent dressings fairly well are much more comfortable and seem to do better because of the relief from frequent disturbance of the wound.

If dressings are done at intervals of several weeks, instead of daily, it is quite possible for the surgeon to give the necessary time to see that his original ideas in regard to the position of the limb, splints, apparatus, etc., are strictly carried out and to have the dressings done under his own eyes so that proper rules of technique and after-care are strictly observed.

All of these are matters of the greatest importance which, in using ordinary antiseptic methods have been neglected or overlooked. By the simple method of drainage and rest as described, all of these points can be kept in mind and constantly observed.

The different effect upon the wound itself is shown by the fact that upon examining the wound for the first time two or three weeks following operation, there is found to be usually less discharge than is found at each dressing when they are changed frequently. This seems to explain why the absorption is less also when the infrequent dressing method is employed.

Naturally, there is a great saving in materials and labor; both the hospital and the attendants benefit by the fact that dressings are done at intervals of several weeks instead of daily or every few days. Furthermore, when dressings are done infrequently it is possible for the surgeon himself to become responsible for the postoperative care of the case. It has been entirely too common for the surgeon, immediately following operation in such cases, to shift the after-care to other and less capable persons.

In the chronic cases, the dressings often get so far away from the surgeon himself that they are done by untrained hospital attendants or even by the patient himself or some member of his family. Secondary mixed infection has therefore been the rule, and the end results in such patients are almost certain to fall far short of what the surgeon had in mind at the time of operation.

Several surgeons who have employed the technique described by the author in the treatment of these cases have made the observation that, whereas the course of the disease following operation and immobilization is very favorable, there is sometimes considerable delay in securing final healing in the late stages of the condition. A careful inquiry into the details of treatment in such cases reveals two important things. First of all, the patients themselves are seldom kept at rest during the late stages of these conditions. As soon as they begin to feel well enough they are allowed to be up and about with limbs hanging down and usually with a reduction in the amount of immobilization. It has been the author's opinion that activities of this sort delay healing and cause a considerable amount of swelling and congestion of the part. This swelling goes down at night and recurs next day. This alternate swollen and congested condition of the diseased area of a lower extremity, for example, certainly interferes with its repair.

It has also been noted that at this stage of the procedure, it is very common to permit some less experienced person to do the dress-

ings. Dressings are also being done more frequently and a wound which has been kept fairly clean and at rest up to the end of 2 or 3 months, immediately takes on a different aspect with an inflamed, irritated surface due to the dressings having been changed by inexperienced persons.

The combination of these two things—decreased immobilization and an increased number of less sterile dressings—will serve to reduce any case to the condition in which these patients have almost always been found, namely, with chronic mixed infected wounds which are slow in healing or which do not heal at all. Such infection may, and usually does, penetrate into the deeper tissue of bone and give additional trouble where sound healing might have occurred if the principles enumerated above had been strictly adhered to.

Table I shows the results in a series of consecutive cases. Many recent cases are omitted as being incomplete.

Just as lives and limbs were saved on the battle fields of France by early immobilization of gunshot fractures in Thomas splints, so there is an opportunity to rescue those who are acutely infected with osteomyelitis, arthritis, and fractures, by prompt fixation in casts or other suitable devices. Drainage is a matter that will often (but not always) take care of itself. If nature is left to do her own immobilizing, life may be preserved, but contracture, deformity, and disability are invariably the result. Early, simple drainage (but thorough), protection against bacterial

TABLE I.—RESULTS IN A SERIES OF CONSECUTIVE CASES

	Diffuse	Local	Compound fracture	Chronic	Preliminary operation	Operation and rest	Second operation	Under treatment	Not traced	Cured	Failure	Died	
W.C. 1		x			x	x	x			x			
L.A. 2		x	x			x				x			
P.C. 3			x			x				x			
F.C. 4		x	x		2	x	x			x			
C.H. 5			x		x	x				x			
D. 6		x			x	x	x						
H.D. 7													
M.E. 8		x		x	x	x				x			
F. 9		x				x				x			
G. 10		x							x				
H. 11		x	x	x	x	x	x			x			
H. 12			x	x		x	x	x	x				
H. 13	x					x				x			
E.H. 14		x		x						x			
K. 15		x		x		x				x			
C.K. 16		x	x			x	x						
K. 17		x	x	x	x					x			
L. 18		x							x				
L.M. 19		x				x				x			
V.M. 20		x	x	x	x	x				x			
M. 21		x				x				x			
McC. 22		x	x			x				x			
E.A.M. 23		x		x	x	x				x			
O.M. 24		x		x		x				x			
L.M. 25		x				x				x			
P.M. 26		x	x			x				x			
L.M. 27		x					x	x					
R.O. 28		x	x		x	x	x			x			
P.P. 29		x		x	x	x		x					
B. 30		x				x				x			
P. 31		x				x				x			
R. 32		x				x				x			
A.R. 33		x		x		x							amputation
S. 34		x				x				x			
E.J.S. 35			x				x			x			
E.S. 36		x				x				x			
D.M.S. 37		x		x		x							amputation

TABLE I.—(*continued*)

S.	38		x	x	x		x				x		
S.	39		x		x	x	x				x		
R.S.	40		x	x		x	x			x			
F.S.	41		x	x	x	x	x	x			x		
F.F.T.	42		x				x				x		
T.T.	43	x			x	x	x	x	x				
M.T.	44		x				x				x		
R.Z.	45			x			x				x		
E.	46			x			x				x		
T.	47	x			x		x				x		

invasion, and fixation in correct position, are the principles of treatment for which adequate methods must be employed.

Our further development of a perfect and applicable technique must not be abandoned until our results are far better than are now being obtained.

ILLUSTRATIVE CASES

CASE 1. L. H. H. This patient sustained a fracture of the right femur in the middle third, on March 22, 1926. He was removed at once to a hospital in a town 18 miles away. Several expedients were tried in an effort to place the fragments in correct position and to secure adequate traction. These having failed, an open reduction was decided upon and this was done on the eighth day. A Lane plate was applied but a traction table was not available and satisfactory position was still not obtained and the plate proved to be inadequate to control the position of the fragments. Furthermore, an infection supervened and in a few days the patient was in great distress both because of failure to control the fracture and a rapidly increasing local and general infection. At this point, the patient came under the care of the writer. A traction device was taken out to the patient (about two hundred miles) who was thought to be too sick for transportation. The patient was placed upon the

traction table under ether, and ice tongs were inserted into the condyles of the femur. Under strong traction upon both the foot and the ice tongs, the leg straightened out and came down to full length. The wound was opened up widely, the steel plate was removed and with a small chisel used as a pin, the fragments were brought into correct position. The chisel was driven in to secure the fragments during the application of the cast. Now the wound was wiped out very thoroughly with tincture of iodine and alcohol and packed with vaseline gauze. A dry gauze dressing was placed over the pack and a double spica cast put on. The patient was kept in bed with the foot of the bed elevated and instructions were given not to open the cast or disturb the dressings except for temperature, swelling, or other signs of inflammation. About ten days later, however, there was some drainage showing through the cast and a little odor; so it was opened up and daily dressings begun. Thereupon, the temperature which had come down, rose again and the discharge increased.

Following a telephone conversation, the patient, was transferred to Lincoln, making the trip, in his cast, without much discomfort. The wound was cleaned up, repacked with vaseline, a cast applied, and a policy of better immobilization and rest for the wound faithfully carried out. The local inflammatory and general symptoms quieted down and the wound went along to nearly complete healing. Solid union of the femur occurred. On June 30, 1926, the man was permitted to return to his home on furlough although it was pointed out to him that there were one or two sequestra forming which would require removal later. Those sequestra have now been removed, the patient's general condition is excellent and he is recovering with a straight limb not more than one-half inch short. (See Figs. 1 to 7.)

Case 2 T. T. I was called in consultation to see this boy after one month's illness in the hospital. He was in desperate condition with an extensive septic involvement of the entire leg extending to the knee. There was tremendous swelling of the limb

as high as the hip and the boy was acutely septic. I was called in to decide the question of amputation and promptly advised against it as it was evident that amputation would cost the boy his life.

An extensive drainage operation for the foot and entire leg was done the same day. Previous drainage had been afforded only by incision through the skin and the soft tissue. Large windows were made in the bony structure of the tarsus and in the upper and lower ends of the tibia. A large sequestrum in the tibia was not removed until later. The wounds were packed wide open with vaseline gauze and the entire limb put in a plaster cast. The limb was put in suspension and traction at once.[1]

At the time of operation the entire leg was full of pus. For the first few weeks drainage was very profuse; at the same time dressings were very infrequent and the packs were not removed oftener than at intervals of from 2 to 4 weeks.

This boy was slow in recovering but left the hospital in about 10 weeks and since that time the wound has been dressed about once a month. He has had four or five changes of cast and is now wearing a caliper splint.

The photograph shows the condition at the end of 12 months. Both the leg and tarsus are practically healed at the present time. Attention is called to the range of motion in the knee which is within a few degrees of normal, this in spite of 8 months in a plaster cast.

The boy is now returning to school and gives every promise of having a useful limb. (Fig. 8.)

Case 3. L. M. This patient came under my observation May 22, 1926. She had sustained an injury to the knee 6 weeks previously. The knee was considerably swollen. X-ray showed an area of destruction in the upper end of the tibia near and under the tibial tubercle. There was much tender-

[1]I consider it desirable to employ suspension in a Balkan frame and traction by means of weight and pulley for all patients with lower extremity osteomyelitis when it is undesirable to use a double plaster spica or a body cast. In small children or in patients difficult to control the double spica is to be preferred. In the upper extremity in children, it is desirable to use the body and arm cast with the arm in abduction, the elbow flexed and the hand supinated. The ordinary aeroplane splint or recumbency with the Blake suspension device may be used.

ness and thickening at that point but no fluctuation. The knee was operated upon the next day and a softened area the size of a large olive was found on the inner side of the upper end of the tibia leading down into the head of the bone. This was opened widely but not curetted. The wound was packed wide open with vaseline gauze and the limb placed in a plaster cast, and was not dressed for one month.

The pain from which she had been suffering severely was relieved immediately and has not returned. The patient was highly neurotic and complained considerably about the cast which, however, was kept on for 3 months. After the third dressing the cast was removed and left off. In September the wound was pronounced healed and has remained healed. There is slight limitation of motion remaining, but she walks about attending to her housework and seems to be making a complete recovery. There is no return of inflammation, swelling or pain. (Fig. 9.)

Case 4. R. H. This patient sustained a compound comminuted fracture in an explosion of a compressed air tank on December 1, 1925. The fracture was in the lower half of the tibia and fibula, and there was a considerable amount of comminution and deformity. The accident occurred on the day when the Central States Orthopedic Clinical Society was meeting in Lincoln and he was operated upon in the presence of some of the members.

Traction was applied on the Hawley table with a pin through the calcaneum. The leg was brought down to full length, the wound was cleaned up. No fragments of bone were removed as the small pieces were found firmly attached. The wound was allowed to remain open, however, and gently packed with vaseline gauze. No dressing was done until December 30, 1925. A little later X-ray showed that there was some lateral displacement of the fragments. A pin was introduced through the skin, the fragments manipulated into nearly correct position, and the pin was driven into the lower fragments, and the cast renewed in such a way as to hold the pin and fragments in this position.

During the next 2 months dressings were done twice, the pin in the meantime having been removed. All wounds were soundly healed at that time and there was beginning but not solid union. Complete bony union was somewhat delayed and the leg was not considered to be solid until after about 6 or 7 months. At about the seventh month he returned to work, not as a machinist but as a shoemaker, walking to and from work with the aid of a double lateral iron on his leg, and crutches. He has continued to improve, the swelling of the limb has almost entirely subsided, and at the end of the eleventh month he is solidly healed in good position.

There is a small amount of shortening due partly to the bone defect and to the fact that exact approximation of the fragments could not be obtained. He has good ankle motion and weight bearing joint for the foot, and the leg is about 95 per cent mechanically correct. There is slight pronation of the foot due to a spreading of the leg bones at the ankle joint which could not be entirely controlled. This is corrected in walking by means of an inside wedge on the heel. (Figs. 10, 11.)

Case 5. W. C., age 19. This patient sustained a simple fracture of the lower third of the humerus in March, 1923. The first treatment failed to give union and four times in 1924 and 1925, operations were performed. Three months before coming to the hospital in Lincoln, another operation was performed and the fragments strongly wired together. Infection unfortunately followed this last attempt and when seen by us there was not only non-union and some deformity, but a stiff elbow and an osteomyelitis involving the entire lower half of the humerus. The patient was in poor general condition.

Our operation (September 18, 1925) consisted of removal of all the wire and two sequestra through a generous incision. The entire wound was packed widely open with vaseline gauze and a body and arm cast put on with the arm well abducted, the elbow flexed and the hand supinated. Following operation, the wound was dressed and he was permitted to return to his home in Kansas. Four weeks later he returned for another dressing. The wound was almost healed

and about 6 weeks later was found quite healed. While in the cast there seemed to be some improvement in stability at the point of fracture and it was determined to stimulate bone production by chipping off a few fragments at the end of the fracture fragments. Through a window in the cast and subcutaneously (outside the scar area) a small chisel was inserted down to the fracture region and with a mallet a few pieces were chipped off and placed in the space between the ends of the bones. As expected, a certain amount of inflammation followed and a small abscess formed which pointed near the olecranon. This was incised and drained and healed in a few days. To our great interest, we found at the end of the next 6 weeks that definite callus was forming and on April 16, 1926, the cast was removed and good union was found to have occurred. A splint was kept on until December 18, 1926, but at the present time the young man is doing light work and using the arm to drive a car and for many other purposes. It is expected that later on, an arthroplasty of the elbow can be done to restore motion to the elbow. There has been no recurrence of the inflammatory process. (Figs. 12, 13.)

Case 6. No. 7005, R. S., age 6 years. This child came 250 miles on the train and was admitted to the hospital September 1, 1926, with a temperature of 105 degrees; pulse, 140; respiration, 32; white blood count, 28,000. There had been pain in the knee and thigh for 3 days previously. Hot packs had been used to allay the discomfort but during the last 24 hours, the least movement of the left lower extremity caused severe pain. The temperature when last taken 12 hours before admission to the hospital was 106 degrees and had been 104 degrees the day before.

The lower third of the left thigh was swollen and tender. There was a definite redness radiating to the outer side of the front lower portion of the thigh. Movement of the knee or hip caused severe pain. The child was negative as to other physical findings except for mild furunculosis on the back of the neck and infection of one finger. X-ray findings were negative as to any bone lesion.

The child was taken to the operating room with a diagnosis of acute osteomyelitis of the lower third of the femur. (Operation by Dr. J. E. M. Thomson, Dr. Orr consulting surgeon.) An incision was made laterally just behind the quadriceps group about 6 inches long. The skin, muscles and periosteum were reflected and a small chisel hole made in the cortex of the metaphysis just proximal to the epiphyseal line. Immediately a yellow, creamy pus welled out. The opening in the bone was extended to about 3 inches long and one-half inch wide so that the entire lower third of the femur was well drained.

Pus exuded freely and was apparently under pressure. Very little curetting of the medullary cavity was done and the wound was filled to the depth of the medulla with a vaseline gauze pack and a double plaster-of-Paris spica cast was applied. In 12 hours his temperature had dropped to 99 degrees; it went up in the afternoon to 101 degrees, but was down the next morning. The temperature ranged within these limits for 3 days; after that the temperature remained under 99.6 degrees for 4 days, after which he had a normal temperature, once or twice rising to 99 degrees and a fraction.

At the end of 6 weeks, the cast was removed and the dressings taken out. There had been considerable drainage under the cast but upon removal of the vaseline pack, the wound had filled in to practically one-half the previous depth and was covered from the base with healthy granulation. A new single spica cast was put on and worn for a month longer, when it was removed and the wound was found to be healed with the dressings pushed entirely out of the wound and the serum which had come from the wound entirely dried.

This wound which had gaped open originally about 2 inches, is now closed to less than one-half inch at the widest portion of the scar. He was placed in a double lateral iron brace and physiotherapy, massage, active and passive motion instituted. Since he has been up and around he has had no temperature and is now (January 10, 1927,—date of photograph) apparently entirely well.

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BIBLIOGRAPHY

Abstracts of War Surgery. Prepared by Division of Surgery, Surgeon General's Office. St. Louis: C. V. Mosby Company, 1918.

Albee, F. H. Osteomyelitis. New York M. J., 1908, June 6.

Tr. Am. Surg. Ass., vol. i, edited by J. E. Mears. Philadelphia: Blakiston Son & Co., 1883.

Beck, Emil G. Present status of joint diseases and best methods of treatment. Surg., Gynec. & Obst., 1914, xviii, 754.

Beckman, E. H. Repair of fractures with steel pins. Surg., Gynec. & Obst., 1912, xiv, 71.

Bell, John. Principles of Surgery. 1826 ed., by Charles Bell in 4 vols. London: Thomas Tegg, 1826.

Blake, Joseph A. Application of methods developed during the war to fractures in civil life. New York M. J., 1920, September 4.

Boorstein, Samuel W. Treatment of fractures by orthopedic methods. Arch. Surg., 1923, November.

Bowlby, Anthony A. Surgical Pathology and Morbid Anatomy. Chicago: W. T. Keener & Co., 1907.

Idem. Results in fractures of femur caused by gunshot. New York M. J., 1920, January 24.

Idem. Growth of surgery of the front in France. Brit. M. J., 1919, August 2.

Byford, W. H. Notes on treatment of compound fractures of extremities. Illinois M. J., 1923, June.

Christie, J. M. Some notes on military orthopedics. Brit. M. J., 1920, June 5.

Clopton, Malvern B. Diagnosis and treatment of osteomyelitis. Surg., Gynec. & Obst., 1925, xx, 6.

Cotton, Frederic J. Dislocations and Joint Fractures. 2d. ed. W. B. Saunders Co., 1924.

Dodd, John M. Treatment and results in fractures. Wisconsin M. J., 1923, July.

Downey, J. H. Angular methods of treating fractures of long bones, both simple and compound. International J. Surg., 1920, March.

Dyas, Fredrick G. Treatment acute osteomyelitis of the long bones by means of dental engine and burrs. J. Am. M. Ass., 1914, April 18.

Idem. The treatment of fracture by nail extension. Surg., Gynec. & Obst., 1916, xxiii, 478.

APR 2 4 1928

Ely, Leonard W. Experimental study of the healing of fractures. Arch. Surg., 1922, November.
Enloe, Newton T. Plaster cast immobilization of fractures to open operation and reduction of same. California St. J. Med., 1921, May.
Estes, W. L. Treatment of fractures. International J. Surg., 1900.
Idem. Compound fractures of bones of extremities. J. Am. M. Ass., 1914.
Gray, Colonel H. M. W. The early treatment of war wounds. Oxford University Press, 1919.
Green, James. Compound comminuted fractures of arm and forearm. Med. Record, 1880, May 15.
Gregoire, Raymond. Vaccine therapy in acute osteomyelitis of adolescents. New York M. J., 1920, October 23.
Guersant, M. P. Surgical diseases of infants and children. Translated by R. J. Dunglison. Philadelphia: Henry C. Lea, 1873.
Harvey, Samuel. An analysis of problem of infection. Military Surgeon, 1918, May.
Heller, Hilda. Detailed bacteriologic study of a case of gas gangrene following compound fracture. Arch. Surg., 1922, March.
Henderson, M. S. End results of fractures. Railway Surg. J., 1915, September.
Henderson, M. S. Non-union in fractures; the massive bone graft. J. Am. M. Ass., 1923, August 11.
Hey, William. Practical observations in surgery. London: Luke Hansard, 1803.
Hill, Roland. Treatment of bone cavities. Mobile M. & S. J., 1908, February.
Hughes, B. Early treatment of comp. fractures of the long bones of the extremities. Brit. M. J., 1917, i, p. 289.
Hunter, John. Hunter's Works. Edited by J. F. Palmer. Philadelphia: Haswell, Barrington, and Haswell, 1841, vols. i, ii, iii, iv.
Jones, Sir Robert. Crippling due to fracture. Brit. M. J., 1925, May 16.
Jones, Everitt O. Treatment compound fractures of the femur. Northwest Med., 1920, June.
Kanavel, Allen B. Infection of the Hand. Philadelphia: Lea and Febiger, 1912.
Keith, Arthur. Menders of the Maimed. London: Henry Frowde and Hodder & Stoughton, 1919.
Koplik. Streptococcus osteomyelitis in children. Am. J. M. Sc., 1892, May.
LaGarde, Louis A. Gunshot Injuries. 2d ed. New York: William Wood & Co., 1916.

LOWMAN, J. B. Treatment of complicated fractures and present opinions of operative treatment. Pennsylvania M. J.

MACEWEN, JOHN A. C. Fractures, Compound Fractures, and Dislocations. Glasgow: Maclehose, Jackson & Co., 1919.

MACFIE, RONALD CAMPBELL. The Romance of Medicine. Cassell and Company.

MANLEY, THOMAS H. Osteomyelitis of tibia. Medical Rec., 1898, December 3.

MARTIN, EDWARD. Open treatment of fractures of the shaft of long bones. J. Am. M. Ass., 1911, October.

MCNAMARA, C. W. Diseases of Bones and Joints. 3d ed. London: J. & A. Churchill, 1887.

MCWILLIAMS, CLARENCE. Mobilization in injured infected and fractured joints. Med. Rec., 1920, September 4.

MCQUILLAN, A. B. Osteomyelitis of traumatic origin. Illinois M. J., 1920, May.

MILLER. Compound comminuted fracture. Boston M. & S. J., 1854, August 9.

MILNE, JOHN S. Apparatus used by Greeks and Romans in setting of fractures and the reduction of dislocations. Interstate M. J., 1909, January.

MOORE, JAMES E. Operative treatment of bad results after fractures. Surg., Gynec. & Obst., 1915, xxi, 650.

MOORHEAD, J. J. Fractures and dislocations. Surg., Gynec. & Obst., 1920, xxxi, 288.

MOSETIG, MOORHOF. Filling for cavities in bones. J. Am. M. Ass., 1903.

MURPHY, JOHN B. Contribution to the surgery of bones, joints, and tendons. Am. M. Ass., 1912, April 20.

O'BRIEN, FRED W. The diagnosis of acute osteomyelitis by X-ray. Boston M. & S. J., 1924, September 11.

ORR, H. W. The fundamental principles of orthopedic reconstruction and industrial surgery. J. Am. M. Ass., 1922, July 22.

Idem. A new method of treatment for bone infection. Orthop. Sect., Am. M. Ass., 1923, June.

Idem. Mechanical versus chemical methods in treatments of wounds. J.-Lancet, 1925, November 1.

ORR, H. W., and THOMSON, J. E. M. Maintaining length and position in the treatments of compound fractures Orthop. Sect., Am. M. Ass., 1924, November 1.

OSGOOD, R. B. Communication from U. S. Army Base Hosp. No. 5. Am. J. Orthop. Surg., 1917, xv, 668.

PAYNE, M. J. Acute infective osteomyelitis with report of cases. Virginia M. Monthly, 1922, November.

PAYNE, JOSEPH FRANK. English medicine in Anglo-Saxon times. Oxford: Clarendon Press, 1904.

PERTHES, G. An important point in treatment of gunshot fractures. Muenchen. med. Wchnschr., 1915, lxii, 754.

PILCHER, LEWIS STEPHEN. The Treatment of Wounds. New York: William Wood & Co., 1899.
PLISSON, L. Gunshot lesions of the diaphyses of long bones. Lyon chir., 1915, xii, 635.
PYE. Surgical Handicraft. First American from the third London ed. 2 vols. New York: E. B. Treat & Co., 1892.
RIDLON, JOHN. Rest in the treatment of chronic joint disease. Med. Rec., 1888, xxxiv, 281.
ROBERTS, JOHN B. Modern treatment of fractures. St. Paul M. J., 1900.
ROOSING, T. Vaccine treatment of chronic osteomyelitis. Brit. M. J., 1923, December 1.
SCHIMMELBUSH, C. The Septic Treatment of Wounds. Translated from the second German edition by Frank J. Thornbury. New York: Knickerbocker Press, 1900.
SCHLESINGER, E. G. Carrel-Dakin method of treating infected wounds. Military Surgeon.
SCHROCK, R. D. Early active motion in intra-articular fractures. J. Am. M. Ass., 1920, November 13.
SENN, N. Osteomyelitis of long bones. Chicago M. J. & Examiner, 1880, January.
Idem. Spontaneous osteomyelitis of long bones. Med. Herald, 1880, March 6.
SENN, E. J. Osteomyelitis of ankle joint, illustrating the utility of bone chip implantation.
SHERMAN, HENRY M. Salt solution as a filling for bone cavities and for vacant spaces in the hard or soft tissue. Surg., Gynec. & Obst., 1911, August.
SHERMAN, W. O'NEILL. Operative treatment of fractures. J. Am. M. Ass., 1912, May 25.
Idem. The Carrel method of wound sterilization. Surg., Gynec. & Obst., 1917, March.
SHERRILL, J. GARLAND. Osteomyelitis in a boy of 9 years. New York, M. J., 1901, September.
SIMMONS, CHANNING. The treatment of osteomyelitis. Surg., Gynec. & Obst., 1915, February.
SINCLAIR, M. Recent changes in fracture treatment Brit. M. J., 1923, December 1.
STEPHENS, RICHMOND. Osteomyelitis following war injuries. J. Orthop. Surg., 1921, April.
STERN, WALTER G. Conservative treatment of bone injury in compound fractures. J. Am. M. Ass., 1924, December 13.
STEVENSON, W. F. Wounds in War. New York: William Wood & Co., 1898.
STOKES, A. C. Three cases of osteomyelitis. Nebraska St. M. J., 1924, May.
STONE, HAROLD W. Treatment of gunshot fractures of the arm. Military Surgeon, 1917, August, 371.

SWOBODA, N. Osteomyelitis in infancy. Pediatrics, 1898, January 1.
THOREK, MAX. Aluminum-potassium-nitrate in treatment of suppurative conditions, particularly osteomyelitis. Ann. Surg., 1923, lxx, 38–47.
WALSHAM. Surgical Pathology. 3d ed. by Herbert J. Paterson. London: Bailliere, Tindall & Cox., 1904.
WINSLOW, NATHAN. Suppurative osteomyelitis due to the colon bacillus. Ann. Surg., 1923, lxx, 319–326.
WORDEN, C. C. Compound fractures involving the ankle-joint. Med. News, 1898, March 12.
WYETH, JOHN A. General Surgery. 4th ed. St. Louis: C. V. Mosby Co., 1912.

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